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A MULTIBAND REMOTE SENSING STUDY OF MELTING SHOREFAST SEA ICE

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Near-shore waters along Alaska's Beaufort sea coast are covered by shorefast sea ice 9 to 10 months each year, and by April the fast ice extends 10 to 50 km seaward along the coast. Recent scientific interest in sea ice dynamics (Maykut et al., 1972) and the prospects for offshore petroleum development in the region (Clark, 1976) highlight the need for a better understanding of the behavior and characteristics of shorefast sea ice.

The objectives of this study were: 1) to evaluate computer-aided analysis techniques as applied to LANDSAT MSS digital data from melting shorefast sea ice, and 2) to determine the nature of the spectral and spatial ice information contained on the LANDSAT data, and the optimal techniques and tools for analysis of each information type.

A LANDSAT scene of June 25, 1974 was selected for computer-aided analysis (using LARSYS) because of cloud-free skies, well developed puddling, and the availability of a relatively large amount of correlative ice data, which included: SLAR imagery and high altitude CIR photography of the study area.

The results of this investigation showed that band 6 is the single most effective band for correctly separating nine spectral classes of ice, and that spectral information redundancy exists between the two visible bands (4 & 5) and also between the two reflective IR bands (6 & 7). Correlation of the LARSYS-defined spectral classes and the "ice-truth" information, indicated that most of the spectral differences on the ice surface were primarily related to differences in proportions (percentages) of ice and puddles within a resolution element (pixel) and to the depth of the puddles. Theoretical calculations of direct-beam spectral reflectance, transmittance, and absorption for surfaces with variable bare ice/puddle percentages and varying puddle depths, corroborate the above findings. Ice deformation was only partially distinguished, and older ice could not be spectrally discriminated from first-year ice with small amounts of meltwater. It was also found that accurate location and interpretation of such ice features as ridges, hummock fields, and possibly some ice age categories can be made when using the LANDSAT data and high altitude color IR photography in conjunction with X-band SLAR information. Thus suggesting that a great deal of useful shorefast sea ice information could be obtained through computer-aided analysis of digitally registered (overlaid) LANDSAT MSS and SLAR data.